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THE SUCCESSION OF FAUNAS IN THE PORTAGE AND CHEMUNG FORMATIONS OF MARYLAND[1]

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In April, 1904, the author visited Great Cacapon, Western Maryland, in company with Messrs. Charles Butts, G. W. Stose, and George C. Martin. At that time certain fossils were observed which, it was believed, might indicate the presence of the Ithaca fauna in Maryland. Subsequent and fuller investigations have been made which have confirmed this view.[2] As the extension of the Ithaca fauna into this area had not been previously noted, it is believed that a brief presentation of the results obtained may be of interest. A résumé of the history of the earlier investigations of the Upper Devonian formations of Maryland will be helpful in understanding the facts to be presented.

HISTORICAL REVIEW

In 1892 Mr. H. N. Darton proposed the name Jennings formation for the Upper Devonian rocks which lie below the Hampshire, and above the Romney in the Staunton, Virginia, quadrangle.[3] The name was subsequently adopted by the Maryland Geological Survey for similar strata in Maryland.

A detailed study of the Upper Devonian formations of western Maryland was made by Professor Charles S. Prosser, assisted by R. B. Rowe, C. C. O'Harra, and others in the years 1898, 1899, and 1900. The fossils collected were described by Dr. J. M. Clarke. A brief statement of the results obtained was published by Professor Prosser in the *Journal of Geology* in 1901.[4]

It was shown that the Jennings formation in Maryland embraces three members which are, in general, equivalent to the Genesee, Portage, and Chemung of New York.

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[1] Published by permission of the Maryland Geological Survey.

[2] A brief statement of this fact was published in *Maryland Geol. Survey*, Vol. V, 1905, and in the Johns Hopkins University Circular, New Series, No. 7, p. 50, 1907.

[3] *American Geology*, Vol. X, 1892, p. 17.

[4] *Journal of Geology*, Vol. IX, pp. 419, 420, 1901.

The fossils described from the Portage were those characteristic of the Naples fauna of New York.[1] A thickness of approximately 2,000 feet was assigned to it in the central part of the area studied.[2]

All strata from which brachiopods were described were assigned to the Chemung. This fauna was known to contain two elements, one characteristic of the Ithaca fauna and another of recognized Chemung facies, while the two elements were supposed to be commingled in the Chemung of Maryland.

The Jennings, though comprising diverse elements, was mapped as a unit because it was deemed impracticable to attempt a cartographic separation of its members at that time.

It appears from the work here discussed that a considerable number of the species previously referred to the Chemung of Maryland occur in reality in the Ithaca facies of the Portage formation. The number of species thus far observed in it is not large, but they are represented by a profusion of individuals.

The various sections will be discribed, those in Washington County being first considered, then those in Allegany County, adjoining it on the west; their faunules will be analyzed, and the correlation of the faunules with those of New York will be finally discussed.

The present article is a preliminary discussion of the results obtained. The author wishes to acknowledge his indebtedness to Mr. D. W. Ohern, Fellow in Johns Hopkins University, for much assistance, particularly in mapping the divisions in Allegany County, and in the measurement and detailed study of a number of the sections.

SECTIONS IN WASHINGTON COUNTY

The Genesee is absent in Washington County.

Great Cacapon.—This section is situated north of the Potomac River opposite Great Cacapon, West Virginia, 8½ miles southwest of Hancock, Md. The strata are well exposed in the cut of the Western Maryland Railroad, standing nearly vertical. They comprise the Portage and part of the Chemung. The base of the Jennings is well marked, on the east, by a massive sandstone which forms the top of the Romney, and which contains Hamilton fossils.

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[1] *Journal of Geology*, Vol. IX, p. 420.

[2] *Maryland Geological Survey*, Vol. VI, Part I, p. 136, 1906.

The lower 500 feet of the Jennings contains only species of the Naples fauna. These are especially abundant at its base where occur various *Goniatites* together with species of the genera *Buchiola, Pterochaenia,* etc. A brachiopod fauna appears above this. At 520 feet above the base of the Jennings *Atrypa reticularis* (L.) occurs, apparently marking the advent of the new fauna. At 735 feet altitude

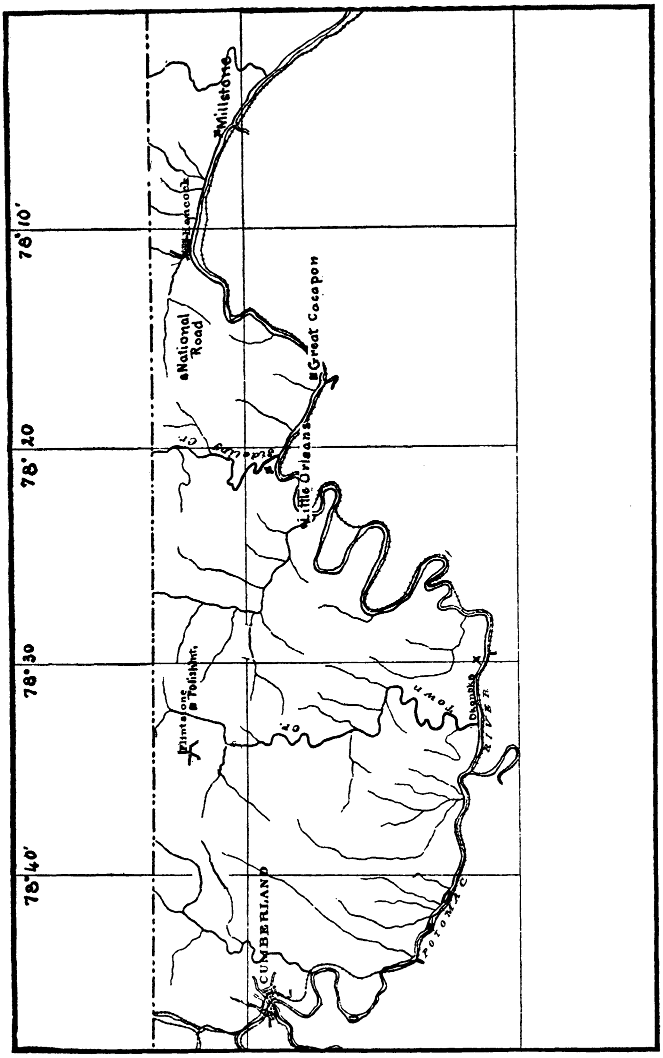

FIG. 1.—Map showing sections in Western Maryland.

Schizophoria striatula (Schloth) was found, a species abundant in the Ithaca of New York, and at 785 feet *Spirifer pennatus* var. *posterus* Hall and Clarke, was observed.

At an altitude of 1,000 feet a profusion of individuals was found belonging to the following species:

Spirifer pennatus var. *posterus* Hall and Clarke, abundant
Productella speciosa Hall, abundant
Leiorhynchus globuliforme (Vanuxem), common
Pugnax pugnus (Martin), common
Cyrtina hamiltonensis Hall, common
Ectenodesma birostratum Hall, rare

Spirifer pennatus var. *posterus* has very long wings, while casts of the ventral valves are without median septum. Individuals of this species are very abundant and well characterized. The forms referred to *Productella speciosa* possess small umbos, and have rather thickly set spines, with small bases.

At 1,400 feet a conglomerate occurs which contains *Camarotoechia congregata.* This seems to be identical with a simularly situated conglomerate farther north, which contains *Camarotoechia congregata* and which will be shown to be referable to the horizon-bearing *Spirifer mesacostalis* at other localities. At 1,750 feet above the base of the Jennings *Spirifer mesastrialis* appears.

The faunules occurring between 520 and 1,000 feet altitude consist of species all of which occur in the Ithaca fauna of New York or Pennsylvania. *Spirifer pennatus* var. *posterus, Productella speciosa, Pugnax pugnus* and *Schizophoria striatula* are characteristic species of the Ithaca fauna of New York, while J. M. Clarke cites *Leiorhynchus globuliforme* as occurring frequently in the same fauna. *Cyrtina hamiltonensis* and *Ectenodesma birostratum* are cited by Kindle and Williams from the Ithaca fauna at Catawissa, Pa. The entire association therefore consists of species occurring elsewhere in the Ithaca fauna and contains no diagnostic Chemung forms. Its position is above the Naples fauna and below the *Spirifer disjunctus* fauna of this section. Thus both in composition and position it appears to be referable to the Ithaca fauna.

In order to ascertain whether Chemung forms may not be mingled with these species at other places, a careful examination was made of similar horizons in a number of localities.

National Road west of Tonoloway Ridge.—The section is exposed along the National Road east of the schoolhouse. The strata dip at high angles and are more or less complicated by minor folds. It is upon the strike northeast of the Great Cacapon section.

The top of the Romney is marked by a massive sandstone which is exposed 250 feet east of the schoolhouse. *Goniatites*, *Buchiola*, etc., occur at the base of the Jennings as in the preceding section, representing the Naples fauna. At 830 feet above the base of the Jennings occur *Spirifer pennatus* var. *posterus* Hall and Clarke, *Schizophoria striatula* (Schloth) and *Productella speciosa* Hall. At 950 feet the following species were observed:

Spirifer pennatus var. *posterus* Hall and Clarke, abundant
Productella speciosa Hall, abundant
Pugnax pugnus (Martin), common
Leiorhynchus globuliforme (Vanuxem), common
Cyrtina hamiltonensis Hall, common

At 1,020 feet *Spirifer pennatus* var. *posterus* aand *Productella speciosa* were observed. A yellow iron-stained conglomerate abounding in *Camarotoechia congregata* (Conrad) occurs at about 1,350 to 1,400 feet above the base of the Jennings. Red bands are seen beneath it. This conglomerate seems to be identical with a similarly situated conglomerate east of Hancock, which there contains *Spirifer mesacostalis*. *Spirifer disjunctus* and its associated forms are found at still higher horizons.

The faunules are thus seen to be similar to those of the Great Cacapon section, which they closely resemble both in composition and altitude. All the species found between 820 and 1,020 feet altitude are found in the Ithaca fauna in New York.

National Road east of Hancock, Md.—The section described is exposed on the National Road beginning just east of the village and extending eastward to Tonoloway Creek. The top of the Romney is marked by a heavy sandstone exposed along the road east of the stream, east of the Catholic church. The Naples fauna was found in the lower part of the Jennings, while above it the following faunules were collected.

750 feet above the base, *Schizophoria striatula* (Schloth)

1000–1100 feet above the base, *Spirifer pennatus* var. *posterus* Hall and Clarke, abundant.

Productella speciosa Hall, abundant
Leiorhynchus globuliforme (Vanuxem), common
Cyrtina hamiltonensis Hall, common
Lingula spatulata Vanuxem?
Spirifer mesastrialis Hall, rare

The above faunule suggests that found at 1,000 feet altitude at Great Cacapon. About 1,500 feet above the base of the Jennings occurs an iron-stained conglomeratic sandstone 1 foot thick, loaded with *Camarotoechia congregata* (Conrad), and bearing also *Camarotoechia eximia* Hall? and *Spirifer mesacostalis* Hall. The latter shows a strongly developed median septum in the ventral valve. Red bands appear just below this stratum, which seems to be identical with the similarly situated conglomerate already mentioned in the preceding section. *Tropidoleptus carinatus* Conrad was obtained in apparently the same horizon south of the Potomac River. About 2,100 feet above the base of the Jennings (at the turn of the road west of Tonoloway Creek) occur:

Spirifer mesastrialis Hall
Chontes scitulus Hall
Ambocoelia umbonata (Conrad)
Orthoceras sp.

Fifty feet above the latter *Spirifer disjunctus* was found.[1]

Harrisonville Road.—This section is exposed on the Harrisonville Road two miles north of Hancock and one mile east of Dogtown, Pa. The lower part of the Jennings contains the Naples fauna. Seven hundred and twenty-five feet above the base of the Jennings the following species were obtained:

Atrypa reticularis (L).
Pugnax pugnus (Martin).
Schizophoria striatula (Schloth).
Camarotoechia sp.
Aulopora (?) sp.

It will be observed that the lower brachiopod fauna appears at about the same altitude in the Great Cacapon section.

Millstone.—This section is exposed on the Western Maryland Railroad one-half mile east of Millstone, and five miles east of Hancock. West of a ravine, one-half mile east of Millstone, occurs a massive conglomeratic sandstone 25 feet thick, bearing the following species:

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[1] This section is complicated by minor folds. The measurements are taken from the section at Berkley Spring which is on the strike of the section discussed and is free from folds.

Spirifer mesastrialis Hall, common
Orthothetes chemungensis (Conrad)
Schizodus gregarius Hall (?), common

The two latter species are poorly preserved.

Two hundred and fifty feet above the preceding occurs a very thick and massive conglomerate, while 370 feet higher *Spirifer disjunctus* was observed. A short distance above the latter *Spirifer mesastrialis* is abundant.

One hundred and eighty feet below the first-named sandstone *Camarotoechia congregata* and *Spirifer mesacostalis* occur as at Hancock in an iron-stained stratum.

Four hundred and sixty feet beneath the *Camarotoechia congregata* zone the following species were observed:

Spirifer pennatus var. *posterus* Hall and Clarke, abundant
Productella speciosa Hall, common
Leiorhynchus globuliforme (Vanuxem)
Cyrtina hamiltonensis Hall

This faunule resembles the *Spirifer pennatus* var. *posterus* faunule of the preceding sections, both in position and composition.

SECTIONS IN ALLEGANY COUNTY

The sections will be examined in their order from east to west. The Genesee is present at the base of the Jennings in this county.

Sideling Creek.—The section is exposed on the west bank of Sideling Creek two miles above its confluence with the Potomac. The stratum there exposed is the lowest observed horizon containing *Spirifer mesacostalis*, *Camarotoechia congregata*, etc. This horizon is more or less conglomeratic in character at most localities, and is believed to represent the western extension of the conglomeratic sandstone bearing *Camarotoechia congregata* and *Spirifer mesacostalis* in the section in Washington County. It is highly fossiliferous, the following species being observed in it:

Atrypa reticularis (L.)
Camarotoechia congregata (Conrad)
Cyrtina hamiltonensis Hall

Productella lachrymosa Conrad
Spirifer mesacostalis Hall
S. marcyi Hall var.
Tropidoleptus carinatus (Conrad)
Goniophora sp.
Cypricardella bellistriata (Conrad)
C. gregaria (Hall)
Nuculites oblongatus Conrad
Leptodesma sp.
Bellerophon maera Conrad
Bellerophon sp.
Bellerophon n. sp.
Cyclonema concinnum Hall
C. hamiltoniae
Coleolus tenuicinctus Hall
Euomphalus laxus Hall
Murchisonia sp.
Pleurotomaria itys Hall
Pleurotomaria n. sp. resembles *P. rotalia* Hall
Phacops rana Green
Bryozoa

Little Orleans.—This section is exposed in the cut of the Western Maryland Railroad. A conglomeratic sandstone occurs just west of the tunnel, bearing the following species:

Spirifer mesacostalis Hall, abundant
Camarotoechia congregata (Conrad), abundant
Nuculites oblongatus Conrad
Goniophora sp.
Bellerophon maera Conrad, abundant
Bellerophon n. sp., approaches *B. acutilira* Hall
Murchisonia n. sp., abundant

The following species were found somewhat below the above horizon, by the wagon road above the railroad:

Cyrtina hamiltonensis Hall
Pugnax pugnus (Martin)
Spirifer pennatus var. *posterus* Hall and Clarke
Leiorhynchus globuliforme Vanuxem
Tropidoleptus carinatus (Conrad)
Productella speciosa Hall
Schizophoria striatula (Schloth)
Stropheodonta demissa Conrad
Ectenodesma birostratum Hall

Nuculites oblongatus Conrad
Palaeoneilo brevis Conrad (?)
Bellerophon maera Conrad
Bellerophon n. sp., approaches *B. acutilira* Hall

It will be observed that this faunule, both in position and composition, is quite similar to the *Spirifer pennatus* var. *posterus* faunule which lies below the conglomerate in the Great Cacapon section.

Fifteen-Mile Creek.—This section is seen on Fifteen-Mile Creek one mile above Little Orleans. A conglomerate is there exposed bearing abundant *Camarotoechia congregata* and *Spirifer mesacostalis.* Three hundred feet below the latter the following species were obtained:

Spirifer pennatus var. *posterus* Hall and Clarke, abundant
Productella speciosa Hall
Schizophoria striatula (Schloth), common
Cyrtina hamiltonensis Hall, common

The relations are here as in the preceeding sections.

Polish Mountain near Gilpin.—This section is exposed along the National Road on the western flank of Polish Mountain. Black shales bearing characteristic Genesee fossils occur at the base of the Jennings southwest of the bridge. The Naples fauna is found in the lower part of the Jennings east of the bridge. Twelve hundred feet above the base of the Jennings at the second turn of the road east of the bridge, the following species were observed:

Spirifer mesacostalis Hall
Spirifer marcyi Hall var.
Tropidoleptus carinatus (Conrad)
Camarotoechia sp.

Fourteen hundred feet above the base of this section *Spirifer mesacostalis* Hall was observed and at 2,000 feet *Spirifer disjunctus* was found.

Section east of Okonoko.—Twelve miles south of the preceding section the Jennings is admirably exposed in the vicinity of Okonoko, in the cuts of the Western Maryland Railroad, north of the Potomac River. About 6,000 feet east of the canal lock, the Hampshire-Jennings contact is observed. At 1,350 feet below the top of the Jennings occurs a massive conglomerate, 20 feet thick. At 3,200 feet below the contact, *Spirifer mesacostalis* was found associated with

Camarotoechia sp. On the eastern limb of an anticline whose axis is 250 lower, the following species were observed:

Spirifer pennatus var. *posterus* Hall and Clarke
Leiorhynchus globuliforme (Vanuxem)
Cyrtina hamiltonensis Hall
Schizophoria striatula (Schloth).

This suggests the *Spirifer pennatus* var. *posterus* faunule of the preceding sections.

Cumberland.—An excellent section is exposed on the Williams Road about 3½ miles east of Cumberland. The Genesee occurs at the base of the Jennings, above which the Naples fauna was found. The lowest horizon of brachiopods observed contained the following species:

Spirifer marcyi Hall var.
Tropidoleptus carinatus (Conrad)
Chonetes scitulus Hall
Productella speciosa Hall
Camarotoechia sappho Hall (?)
Leptodesma sp.
Orthoceras sp.

Spirifer mesacostalis was found, apparently at the same horizon, a short distance southwest of this locality. The *Spirifer pennatus* var. *posterus* fauna has not been observed in this section.

Allegany Grove.—The section is exposed in the cuts of the C. P. and G. C. C. R. R., extending from the Winchester road westwards. The lower Jennings is abnormally thin in this section, as is also the Romney. This is probably due to compression in folding. The Naples fauna was found near the base of the section. The following species were observed at the altitudes named, above the base of the Jennings:

675	feet	altitude,	*Camarotoechia congregata* (Conrad)
850	"	"	*Productella speciosa* Hall (?)
850	"	"	*Leiorhynchus mesacostale* Hall (?)
850	"	"	*Cyrtina hamiltonensis* Hall
850	"	"	*Pterinea chemungensis* Conrad
1,100	"	"	*Spirifer mesacostalis* Hall, abundant
1,400	"	"	*Spirifer mesacostalis* Hall, abundant
1,600	"	"	*Orthothetes chemungensis* (Conrad)
1,800	"	"	*Stropheodonta (Douvillina) cayuta* Hall
1,800	"	"	*Orthothetes chemungensis* (Conrad)

The species occurring at 850 feet altitude are rare and poorly preserved. In position and composition they seem to be referable to the *Spirifer pennatus* var. *posterus* fauna which would appear to be very slightly developed here. *Spirifer disjunctus* occurs at 1,300 feet above the base of the Jennings at Ellerslie, six miles northeast on the strike of the preceding section.

ANALYSIS OF FAUNAS

An examination of the preceding lists shows that certain faunas may be discriminated in the Upper Devonian of Maryland, which are well characterized both by their composition and position. They may be designated as follows:

TABLE I

SPECIES OBSERVED IN THE *Spirifer pennatus* VAR. *posterus* FAUNA

	OCCURRENCE IN		
	Hamilton	Portage	
		New York	P'nsylvania
Atrypa reticularis (L.), r	*	*	*
Camarotoechia congregata (Conrad), r	*	*	
Cyrtina hamiltonensis Hall, c	*	*	*
Leiorhynchus globuliforme (Vanuxem), c		*	?
Leiorhynchus mesacostale Hall, rr		*	*
Lingula spatulata Vanuxem, r		*	
Productella speciosa Hall, a		*	*
Pugnax pugnus (Martin), c		*	*
Schizophoria striatula (Schloth), c	*	*	*
Spirifer mesastrialis Hall, rr		*	*
Spirifer pennatus var. posterus Hall & Clarke, a		*	*
Stropheodonta demissa Conrad, r	*	*	*
Tropedoleptus carinatus Conrad, r	*	*	*
Nuculus oblongatus Conrad, r	*	*	
Palaeoneilo brevis Hall (?), r		*	*
Ectenodesma birostratum Hall, c			*
Pterinea chemungensis Conrad, rr			*
Bellerophon sp., r			
Bellerophon n. sp., r			
Bellerophon maera Conrad		*	*
Bellerophon n. sp. approaches B. acutilira Hall			

Spirifer disjunctus fauna
Spirifer mesacostalis fauna
Spirifer pennatus var. *posterus* fauna
Naples fauna
Genesee fauna

These faunas are to be traced throughout most of the area discussed. Their relations are indicated upon the accompanying chart. Their constancy of composition, shown by their predominating species, and their occurrence at the same relative position in the various sections, seem to indicate that they are recognizable units, and that they preserve their integrity throughout the area discussed. If we assume that the species occurring in the same relative position in the various sections belong to one fauna, the lists in Tables I and II may be taken as

TABLE II

SPECIES OBSERVED IN THE *Spirifer mesacostalis* FAUNA

	Occurrence in		
	Hamilton	Portage	
		New York	P'nsylvania
Atrypa reticularis (L.), r	*	*	*
Camarotoechia congregata (Conrad), aa	*	*	
Camarotoechia eximia Hall, r	*	*	*
Camarotoechia sappho Hall (?), r	*		*
Cyrtina hamiltonensis Hall, c	*	*	*
Chonetus scitulus Hall	*	*	*
Productella lachrymosa (Conrad), a		*	
Lingula sp			
Spirifer mesacostalis Hall, aa		*	
Spirifer marcyi Hall var	*	*	
Tropidoleptus carinatus (Conrad), aa	*	*	*
Goniophora glaucus Hall	*		
Goniophora sp			
Goniophora n. sp			
Cypricardella bellistriata (Conrad)	*		*
Cypricardella gregaria (Hall)	*		*
Nuculites oblongatus Conrad	*	*	
Leptodesma sp			
Bellerophon maera Conrad		*	*
Bellerophon sp			
Bellerophon n. sp			
Bellerophon n. sp. approaches B. acutilira Hall	*		
Cyclonema concinnum Hall	*		
Cyclonema hamiltoniae Hall	*		
Coleolus tenuicinctus Hall	*		
Euomphalus laxus Hall	*	*	
Murchisonia sp	*	*	
Murchisonia n. sp			
Pleorotomaria itys Hall	*	*	
Pleurotomaria n. sp. resembles P. rotalia Hall	*		
Platyceras sp			
Platyceras n. sp			
Orthoceras sp			
Trochoceras n. sp			
Phacops rana Green	*	*	
Bryozoa, 2 species			

indicating all the species thus far observed in each fauna. (Only those occurring in the three lower brachiopod faunas will be cited here.)[1]

CORRELATION OF THE FAUNAS

We may now examine the problem of the correlation of the Upper Devonian faunas of Maryland with those of New York and Pennsylvania by the use of the data given above.

Genesee Fauna.—The Genesee of Maryland, as has been shown by earlier students of the problem, bears a fauna very similar to that of the Genesee of New York which it also resembles in thinning out and disappearing toward the east.

Naples fauna.—Above the Genesee, in the western sections, or immediately overlying the Hamilton, in the eastern sections, are smooth fissile shales and interbedded sandstones carrying *Goniatites*, *Buchiola*, *Pterochaenia*, etc., as in the Naples fauna of New York. These strata are about 700 feet thick in the Allegany Grove Section. They increase considerably in thickness in the vicinity of Cumberland, and thin to about 500 feet in the eastern sections. The correlation of this division has been previously discussed by Professor Prosser[2] who assigned to it a thickness of about 2,000 feet in the central part of the area.[3]

Spirifer pennatus var. *posterus fauna.*—This fauna occurs immediately above the Naples fauna. It is of wide extent and is especially developed in the eastern sections. It is characterized by the abundance of *Spirifer pennatus* var. *posterus*, *Productella speciosa*, *Pugnax pugnus*, *Cyrtina hamiltonensis*, *Schizophoria striatula*, and *Leiorhynchus globuliforme* at most of its localities. The complete list of species observed in it is given on a preceding page. Of these, five, *Spirifer pennatus* var. *posterus*, *Productella speciosa*, *Tropidoleptus carinatus*, *Cyrtina hamiltonensis*, *Spirifer mesastrialis*, and *Leiorhynchus mesacostale* are placed by Williams[4] among the dominant species of the Ithaca fauna, which he has named the *Productella speciosa* fauna, while *Pugnax pugnus* and *Schizophoria striatula* are also prominent members of that fauna. *Leiorhynchus globuliforme* is also quoted by

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[1] The new species here cited will be described later in the *Report on the Devonian of Maryland*, to be issued by the Maryland Geological Survey.

[2] *Journal of Geology*, Vol. IX, pp. 419, 420, 1901.

[3] *Maryland Geology Survey*, Vol. VI, Part I, p. 136, 1906.

[4] *Bulletin of the U. S. Geological Survey*, No. 210, p. 74, 1903.

Clarke[1] as frequently present in it in New York. It contains one species, *Pterinea chemungensis*, which is stated by Williams to be characteristic of the Chemung of New York.[2] This species is, however, cited from the Ithaca of New York by Clarke[3] and is quoted by Williams and Kindle[4] in what they regard as the Ithaca fauna in the Catawissa, Pa., fauna. The occurrence of this species therefore does not seem sufficient to determine the Chemung age of the fauna. All the species contained in the list, save one, are found in the Ithaca fauna of New York,[5] and that exception, *Ectenodesma birostratum*, is found in the Ithaca fauna in the section at Catawissa, Pa.[6] These facts would seem to indicate the Ithaca age of this fauna.

It is interesting to note that *Ectenodesma birostratum* and *Pterinea chemungensis* are restricted to the upper zone of the Ithaca fauna of the Catawissa section, and are also restricted to the upper zone of the fauna in Maryland. Indeed, there are numerous resemblances between the upper horizons of the two sections.

There is also a resemblance between this fauna and the Leiorhynchus globuliforme fauna found above the Oneonta sandstone of New York, as shown by the following list of species of brachiopods occurring at Cowles Hill, Greene, New York.[7]

Atrypa reticularis
Schizophoria impressa (=*S. Striatula*)
Leiorhynchus globuliforme
Spirifer mucronatus (=*pennatus*) var.
Productella speciosa
Stropheodonta demissa
Spirifer laevis
Cyrtina recta
Leptostrophia mucronata

The resemblance is very close. It will be noted that *Spirifer laevis* is quoted by Kindle and Williams from the upper zone of the Ithaca fauna at Catawissa, Pa. Clarke[1] and Prosser[2] refer the Cowles Hill fauna to the Chemung, Williams to the Ithaca.

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[1] *Ithaca Fauna of Central New York*, Bulletin 82, N. Y. State Mus., p. 64, 1905.

[2] *Journal of Geology*, Vol. XV, p. 98, 1907.

[3] *Bulletin 82*, N. Y. State Museum, p. 62, 1905.

[4] *Bulletin of the U. S. Geological Survey*, No. 244, p. 77, 1905.

[5] *Bulletin 82*, N. Y. State Mus., pp. 61–65, 1905.

[6] Kindle and Williams, *Bulletin of the U. S. Geological Survey*, No. 244, p. 77, 1905.

[7] *49th Ann. Rept.* for 1895, N. Y. State Museum, Vol. II, pp. 36–38, 1898.

Spirifer mesacostalis fauna.—This fauna occurs above the preceding and is present throughout the entire area. Its dominant forms are *Tropidoleptus carinatus, Spirifer mesacostalis, Spirifer marcyi* and many gastropods. The list of species observed is given on a preceding page. Many of these have marked Hamilton affinities. This is especially true of the dominant brachiopods which include:

Tropidoleptus carinatus (Conrad)
Camarotoechia congregata (Conrad)
Spirifer mesacostalis Hall (cf. *S. consobrinus* of the Hamilton)
Spirifer marcyi Hall var.
Cyrtina hamiltonensis Hall

Goniophora glaucus Hall, *Coleotus tenuicinctus* Hall, and *Phacops rana* are also suggestive of Hamilton affinities. One species, *Productella lachrymosa* is quoted by Williams[3] as diagnostic of the Chemung in the Watkins, New York, quadrangle. Clarke, however, quotes it as of frequent occurrence in the Ithaca further east.[4] All of the forms specifically determined, save *Cyclonema concinnum,* are found in the Ithaca fauna.[5] These facts seem sufficient to refer this fauna to the Portage formation. In certain respects it resembles the Enfield fauna of Williams which, according to him, lies in the Nunda above the Ithaca and below the Chemung in the Watkins quadrangle. The following species of the above list are quoted by him as characteristic of that horizon: *Tropidoleptus carinatus, Spirifer marcyi, Delthyrus mesacostalis,* and numerous gastropods.[6] It will be noted that this fauna occupies a similar position in Maryland.

Spirifer disjunctus fauna.—The lowest observed occurrence of *Spirifer disjunctus* is in general 400–700 feet above the base of the *Spirifer mesacostalis* fauna. With it are associated *Douvillina cayuta* and *Camarotoechia contracta,* which have not been observed in the preceding faunas. *Spirifer mesastrialis* is also abundant in the fauna while it has been observed but rarely at lower horizons in Maryland.

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[1] *49th Ann. Rept.,* for 1895, N. Y. State Museum, Vol. II, p. 39, 1898.

[2] *Ibid.,* p. 165.

[3] *Journal of Geology,* Vol. XV, p. 98, 1907.

[4] *Bulletin 82,* N. Y. State Museum, p. 64, 1905.

[5] *Ibid.,* pp. 61–65.

[6] *Journal of Geology,* Vol. XV, p. 109, 1907.

PORTAGE-CHEMUNG BOUNDARY

It is very difficult to determine this horizon when the brachiopod facies of the Portage immediately underlies the Chemung. Of the New York section Clarke remarks "It is extraordinarily difficult to fix on a division plane between the Ithaca and the overlying Chemung faunas."[1] If this be true in New York, it must be still more true when an attempt is made to correlate that section with those of other states, and the results attained must be open to revision as fuller investigations give increased data. Nevertheless, it seems reasonably probable from the preceding studies, that the horizon in question is to be placed between the strata bearing the *Spirifer disjunctus* and *Spirifer mesacostalis* faunas, giving the following succession:

Chemung, Spirifer disjunctus fauna
Portage { Spirifer mesacostalis fauna
Portage { Spirifer pennatus var. posterus fauna
Portage { Naples fauna
Genesee, Black shales with Buchiola fauna

Lithologically the horizon is not well defined, the conditions varying at different localities. In general the Portage is characterized by smooth fissile shales and interbedded sandstones and the Chemung by a larger percentage of sandstones, while its shales are softer and break with a hackly fracture. The transition from Portage to Chemung is however not sharply defined by any lithological features.

GENERAL RELATIONS

Certain general facts seem to harmonize with those of New York.

1. The general succession of forms seems to be that of New York. At the base occurs the Genesee thinning eastward, followed by the Naples fauna of the Portage. Above the latter is found *Spirifer pennatus* var. *posterus,* succeeded by *Spirifer mesacostalis,* and finally by *Spirifer disjunctus.*

2. There is a greater development of the Naples fauna in the west and of the Ithaca fauna in the east.

3. The shore line was probably eastward as indicated by the fact that there is a marked development of conglomerates eastward, as at Millstone. These diminish toward the west where the lower Jennings is largely composed of argillaceous shales, as at Allegany Grove.

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[1] *Memoir 6,* N. Y. State Museum, p. 213, 1904.

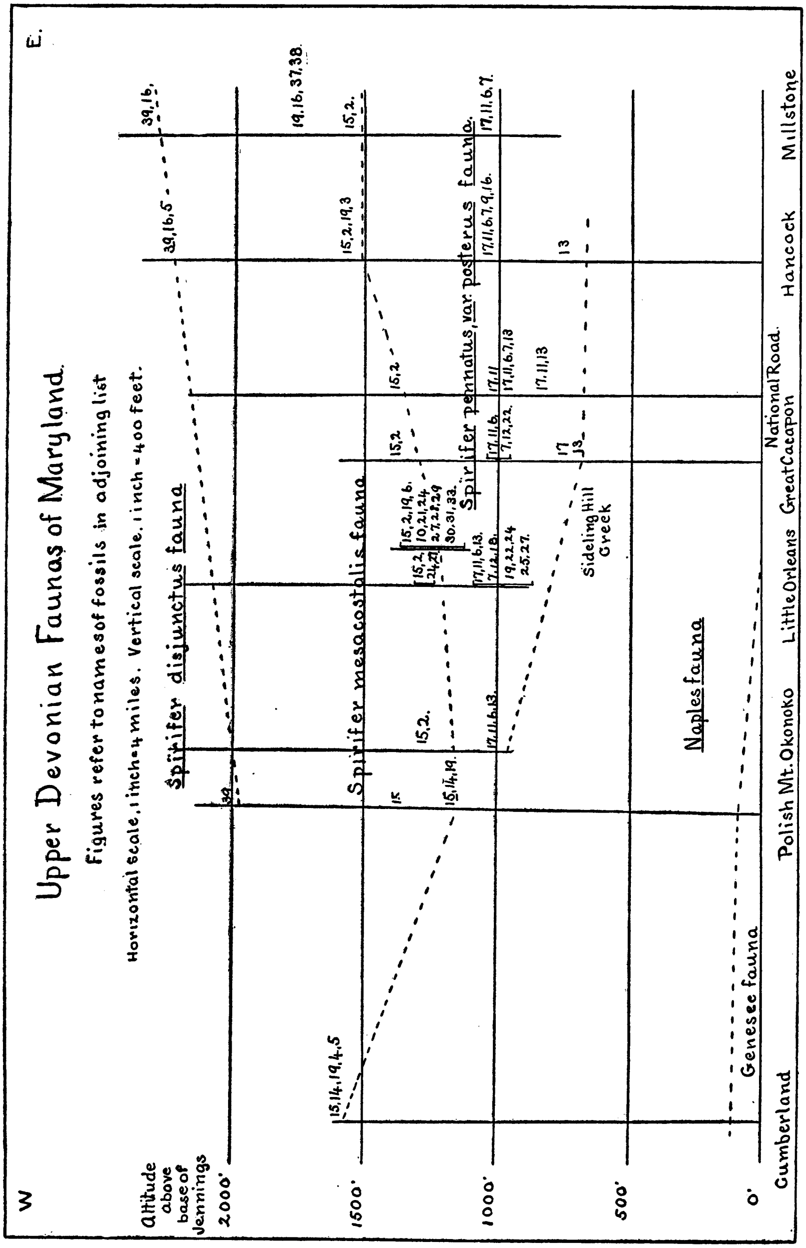
Upper Devonian Faunas of Maryland.
Figures refer to names of fossils in adjoining list
Horizontal scale, 1 inch = 4 miles. Vertical scale, 1 inch = 400 feet.
W
E.
Altitude above base of Jennings
2000'
1500'
1000'
500'
0'
Spirifer disjunctus fauna
Spirifer mesacostalis fauna
Spirifer pennatus, var. posterus fauna
Naples fauna
Genesee fauna
Cumberland
Polish Mt.
Okonoko
Little Orleans
Great Cacapon
Sideling Hill Creek
National Road.
Hancock
Millstone
15,14,19,4,5
39
15
15,14,19.
15,2.
17,11,6,13.
17,11,6,13.
7,12,18.
15,2
24,21
15,2,19,6.
10,21,24
27,28,29
30,31,33.
19,22,24
25,27.
15,2
17,11,6.
17,12,22.
17
13
15,2
17,11
17,11,6,7,13
17,11,13
15,2,19,3
39,16,5
13
17,11,6,7,9,16.
15,2.
19,16,37,38.
39,16.
17,11,6,7.

FIG. 2

TABLE III

UPPER DEVONIAN FAUNAS OF MARYLAND

The numbers on accompanying chart indicate the fossils of subjoined list. Only forms specifically identified from the brachiopod fauna of the middle and lower Jennings are recorded.

	HAMILTON	PORTAGE		PORTAGE OR HAMILTON
		New York	Pennsylvania	
1. Atrypa reticularis (L.)	*	*	*	*
2. Camarotoechia congregata (Conrad)	*	*		*
3. Camarotoechia eximia Hall	*	*	*	*
4. Camarotoechia sappho Hall (?)	*	*		*
5. Chonetes scitulus Hall	*	*	*	*
6. Cyrtina hamiltonensis Hall	*	*	*	*
7. Leiorhynchus globuliforme (Vanuxem)		*	?	*
8. Leiorhynchus mesacostale Hall		*	*	*
9. Lingula spatulata Vanuxem		*		*
10. Productella lachrymosa (Conrad)		*		*
11. Productella speciosa Hall		*	*	*
12. Pugnax pugnus (Martin)		*	*	*
13. Schizophoria striatata (Schloth)	*	*	*	*
14. Spirifer marcyi Hall var		*		*
15. Spirifer mesacostalis Hall		*		*
16. Spirifer mesastrialis Hall		*	*	*
17. Spirifer pennatus var. posterus Hall & Clarke		*	*	*
18. Stropheodonta demissa Conrad	*	*	*	*
19. Tropidoleptus carinatus (Conrad)	*	*	*	*
20. Cypricardella bellistriata (Conrad)	*		*	*
21. Cypricardella gregaria (Hall)	*	*		*
22. Ectenodesma birostratum Hall			*	*
23. Goniophora glaucus Hall	*			*
24. Nuculites oblongatus Conrad	*	*		*
25. Palaeoneilo brevis Hall?		*	*	*
26. Pterinea chemungensis Conrad	*	*		*
27. Bellerophon maera Conrad		*	*	*
28. Cyclonema concinnum Hall?				
29. Cyclonema hamiltoniae Hall	*			*
30. Euomphalus laxus Hall	*	*		*
31. Pleurotomaria itys Hall	*	*		*
32. Coleolus tenuicinctus Hall	*	*		*
33. Phacops rana Green	*	*		*
34. Ambocoelia umbonata (Conrad)				
35. Dalmanella tioga Hall				
36. Douvillina cayuta Hall & Clarke				
37. Orthothetes chemungensis (Conrad)				
38. Schizodus gregarius Hall				
39. Spirifer disjunctus Sowerby				

4. An interesting additional feature is that there is an earlier development of red beds in the eastern sections. Red strata appear below the top of the Portage in the east, but become marked only toward the

close of the Chemung in the western sections, a fact noted by earlier investigators of the Jennings.

5. The Chemung closes with the incoming of the nearly unfossiliferous red strata of the Hampshire, which are similar to those of the Catskill of New York.

The facts given indicate that the Ithaca fauna extends southward into Maryland, and that there was a general agreement in many of the conditions in New York and Maryland in Portage and Chemung time.